U.S. Application No.
Unknown

International Application No.
PCT/NL00/00297

Attorney Docket No.
NEDER28.001APC

Date: November 6, 2001

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 USC 371

International Application No.: PCT/NL00/00297
International Filing Date: May 8, 2000
Priority Date Claimed: May 7, 1999
Title of Invention: METHOD FOR TRANSFERRING WAFERS AND RING
Applicant(s) for DO/EO/US: Vladimir Ivanovich Kuznetsov, Theodorus Gerardus Maria Oosterlaken, Christianus Gerardus Maria Ridder and Ernst Hendrik August Granneman

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

(X) This is a **FIRST** submission of items concerning a filing under 35 USC 371.

(X) This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).

(X) A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

(X) A copy of the International Application as filed (35 USC 371(c)(2))

a) () is transmitted herewith (required only if not transmitted by the International Bureau).
b) (X) has been transmitted by the International Bureau.
c) () a copy of Form PCT/1B/308 is enclosed.
d) () is not required, as the application was filed in the United States Receiving Office (RO/US).

(X) Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3))

e) () are transmitted herewith (required only if not transmitted by the International Bureau).
f) () have been transmitted by the International Bureau.
g) () have not been made; however, the time limit for making such amendments has NOT expired.
h) (X) have not been made and will not be made.

(X) A combined Declaration and Power of Attorney of the inventors (35 USC 371(c)(4)).

(X) An Information Disclosure Statement under 37 CFR 1.97 and 1.98 and PTO Form 1449 and fourteen (14) references.

(X) An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

(X) International Application as published (with attached International Search Report).

(X) A FIRST preliminary amendment.
(X) Five (5) sheets of drawings.

(X) A return prepaid postcard.

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JC13 Rec'd PCT/PTO 06 NOV 2001

Date: November 6, 2001

(X) The following fees are submitted:

				FEES
	BASIC FEE			$890
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total Claims	26 - 20 =	6 ×	$18	$108
Independent Claims	5 - 3 =	2 ×	$84	$168
Multiple dependent claims(s) (if applicable)			$280	$0
	TOTAL OF ABOVE CALCULATIONS		$1,166	
Reduction by 1/2 for filing by small entity (if applicable).			$0	
	TOTAL NATIONAL FEE			$1,166
	TOTAL FEES ENCLOSED			$1,166

(X) A check in the amount of $1,166 to cover the above fees is enclosed.

(X) Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40 per property.

(X) The Commissioner is hereby authorized to charge only those additional fees which may be required, now or in the future, to avoid abandonment of the application, or credit any overpayment to Deposit Account No. 11-1410.

SEND ALL CORRESPONDENCE TO:

Gordon H. Olson

Gordon H. Olson
Reg. No. 20,319
Customer No. 20,995

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NEDER28.001APC

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Kuznetsov, et al.	Group Art Unit Unknown
Appl. No.	:	Unknown	I hereby certify that this correspondence and all marked attachments are being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on 11/6/01 (Date)
Filed	:	Herewith	
For	:	METHOD FOR TRANSFERRING WAFERS AND RING	Gordon H. Olson, Reg. No. 20,319
Examiner	:	Unknown	

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to examination of the above-captioned application, please amend the application as follows:

IN THE SPECIFICATION:

Please amend the specification, published as International Application WO 00/68977, as follows:

On page 1, line 2, please insert --Field of the Invention--.

Please amend the paragraph beginning on page 1, line 3, as follows:

The present invention relates to a method of transferring a wafer between a thermal treatment chamber and a thermal treatment installation.

Background of the Invention

Appl. No. : **Unknown**
Filed : **Herewith**

U.S. Patent No. 5,162,047 discloses a thermal treatment installation which comprises a thermal treatment chamber, a "wafer boat"/rings assembly, a loading device and a transport device. With this arrangement the loading device serves to place wafers in and to remove wafers from the assembly and the transport device serves to place the assembly in and remove the assembly from the thermal treatment chamber.

On page 2, between lines 24 and 25, please insert --<u>Summary of the Invention</u>--.

Please amend the paragraph beginning on page 3, line 10, as follows:

An aspect of the present invention involves a method of transferring wafers between a thermal treatment chamber and a thermal treatment installation. The treatment chamber has a top section and a bottom section between which the wafer is accommodated during treatment. The thermal treatment installation has a loading chamber having loading means and transport means. The wafer is place on a wafer support while in the loading chamber, wherein the wafer support is configured as a ring having support elements to support the wafer. The wafer support loaded with the wafer is inserted into the thermal treatment chamber so that the wafer and the wafer support are positioned between the top section and the bottom section. The wafer is individually processed in the thermal treatment chamber. After processing the wafer, the wafer support is removed from the thermal treatment chamber.

On page 5, between lines 13 and 14, please insert --<u>Brief Description of the Drawings</u>--.

On page 5, between lines 31 and 32, please insert --<u>Detailed Description of the Drawings</u>--.

On page 9, before line 1, please replace "Claims" with -- WHAT IS CLAIMED IS --.

Please add an abstract on a separate page that is enclosed hereto.

<u>IN THE CLAIMS:</u>

Please cancel Claims 1-21, published in WO 00/68977, without prejudice.

Please add the following new claims:

22. (New) A method for transferring a wafer into or from a thermal treatment chamber, said treatment chamber comprising a top section and bottom section between which the wafer is accommodated during treatment, said treatment chamber being associated with a thermal treatment installation which comprises a loading chamber, which has a temperature differing from a temperature of said thermal treatment chamber, loading means and transport means being provided therefor in the loading chamber, wherein in the loading chamber one of a set of wafers and a ring are combined to a wafer/ring combination by the loading means and wafer/ring combinations are inserted into and withdrawn from the thermal treatment chamber by the transport means, wherein said thermal treatment chamber is embodied for treating one wafer at a time and wherein wafer/ring combinations are individually inserted in between and withdrawn from in between the top and bottom section of the thermal treatment chamber.

23. (New) The method of Claim 22, wherein both sides of a wafer are directly adjacent to said top section and bottom section.

24. (New) The method of Claim 22, wherein during transfer of the wafer treatment/ring combination a reactor temperature is at least 900° C.

25. (New) The method of Claim 22, wherein during movement of the wafer/ring combination the ring is handled mechanically and the wafer bears on support points on said ring.

26. (New) The method of Claim 22, wherein during movement the ring and the wafer are supported by an auxiliary element, which auxiliary element is handled mechanically.

27. (New) The method of Claim 26, wherein vacuum is used in the transport means on a contact surface between the wafer and the auxiliary element in order to hold the wafer in place.

28. (New) The method of Claim 22, wherein in said thermal treatment installation the wafer surrounded by the ring is at a distance of less than 1 mm away from, or in contact with, a horizontal and essentially flat heated reactor section in said thermal treatment installation by vertical movement of the wafer with respect to the heated reactor section.

29. (New) The method of Claim 22, wherein the essentially horizontal wafer is moved a vertical distance away from the ring in said thermal treatment chamber.

30. (New) The method of Claim 29, wherein contact-free treatment of the wafer takes place in said thermal treatment chamber, the wafer being moved by a gas stream a vertical distance away from the ring.

31. (New) The method of Claim 22, wherein the thermal treatment installation comprises a transport chamber which is connected to the loading chamber and to the thermal treatment chamber.

32. (New) The method of Claim 31, wherein the wafer is surrounded, without contact, by the ring in said transport means.

33. (New) The method of Claim 32, wherein the wafer is a vertically spaced from support points of the ring by a gas stream.

34. (New) A thermal treatment installation/ring combination comprising a loading chamber, loading means, transport means and a thermal treatment chamber for carrying out a thermal treatment, said thermal treatment chamber comprising a top section and a bottom section located opposite to each other and between which a wafer can be accommodated for carrying out a thermal treatment, said transport means being equipped to move wafer/ring combinations from the loading chamber into the thermal treatment chamber and vice versa, wherein said thermal treatment chamber is configured to carry out a thermal treatment on one wafer at a time, said transport means being equipped to move individual wafer/ring combinations from the loading chamber and insert said individual wafer/ring combination into the thermal treatment chamber and vice versa, wherein the thermal treatment chamber is configured to accommodate said ring surrounding the wafer.

35. (New) The thermal treatment/ring combination of Claim 34, wherein said top section and bottom section are provided with heating means.

36. (New) The thermal treatment installation/ring combination of Claim 34, wherein an internal diameter of an inner edge of the ring is larger than an external diameter of the wafer.

37. (New) The thermal treatment installation/ring combination of Claim 34, wherein the ring is configured to support said wafer at least during transfer.

38. (New) The thermal treatment installation/ring combination of Claim 37, wherein the ring is mechanically joined to the transport means.

39. (New) The thermal treatment installation/ring combination of Claim 34, wherein the treatment chamber is configured to accommodate an auxiliary element for supporting the ring and the wafer at least during transfer.

40. (New) The thermal treatment installation/ring combination of Claim 39, wherein said auxiliary element is mechanically joined to the transport means.

41. (New) The thermal treatment installation/ring combination of Claim 34, wherein said ring is provided with heating means.

42. (New) A thermal treatment installation/ring combination, wherein a thermal treatment installation comprises a treatment chamber delimited by two opposite sections, at least one of said sections being provided with a gas supply for positioning a wafer floating between said sections, said ring configured to be placed between said sections, wherein in an operating position a distance between said two sections at a location of said ring substantially corresponds to a thickness of said ring, and wherein at least three radial gas passages are arranged between said ring and at least one section.

43. (New) The thermal treatment installation/ring combination of Claim 42, wherein said passages are provided in said sections.

44. (New) A ring combination comprising a ring and a support ring, an internal diameter of which is larger than an external diameter of the ring and which is provided with support elements which extend within an inner circumference of said ring.

45. (New) The ring combination of Claim 44, wherein said support elements comprise pins which are accommodated in grooves.

46. (New) The ring combination of Claim 45, wherein said support elements are provided with internal channels which at one end open onto a contact surface with the wafer and at another end are in communication with an internal channel in the support ring, which channel is connected to vacuum means in order to produce a vacuum in the channels.

47. (New) A method for transferring a wafer between a thermal treatment chamber and a thermal treatment installation, said treatment chamber comprising a top section and bottom section between which the wafer is accommodated during treatment, said thermal treatment installation comprising a loading chamber having loading means and transport means, said method comprising:

placing a wafer on a wafer support while in the loading chamber, wherein the wafer support is configured as a ring having support elements to support the wafer;

inserting the wafer support loaded with the wafer into the thermal treatment chamber so that the wafer and the wafer support are positioned between the top section and the bottom section;

individually processing the wafer in the thermal treatment chamber; and

removing the wafer support from the thermal treatment chamber after processing the wafer.

REMARKS

The specific changes to the specification and the amended claims are shown on a separate set of pages attached hereto and entitled **VERSION WITH MARKINGS TO SHOW CHANGES MADE**, which follows the signature page of this Amendment. On this set of pages, the insertions are underlined while the ~~deletions are struck through~~.

The foregoing amendments are to more closely conform the application to U.S. practice. No new matter is added. Entry of the amendments is respectfully requested.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 11/6/01

By: Gordon H. Olson

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Appl. No. : Unknown
Filed : Herewith

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning on page 1, line 3, has been amended as follows:

The present invention relates to a method ~~according to the preamble of Claim 1~~of transferring a wafer between a thermal treatment chamber and a thermal treatment installation.

Background of the Invention

U.S. Patent No. 5,-162,-047 discloses a thermal treatment installation which comprises a thermal treatment chamber, a "wafer boat"/rings assembly, a loading device and a transport device. With this arrangement the loading device serves to place wafers in and to remove wafers from the assembly and the transport device serves to place the assembly in and remove the assembly from the thermal treatment chamber.

The paragraph on page 3, line 10, has been amended as follows:

~~The aim is achieved with a method as described above having the characterising features of claim 1.~~An aspect of the present invention involves a method of transferring wafers between a thermal treatment chamber and a thermal treatment installation. The treatment chamber has a top section and a bottom section between which the wafer is accommodated during treatment. The thermal treatment installation has a loading chamber having loading means and transport means. The wafer is place on a wafer support while in the loading chamber, wherein the wafer support is configured as a ring having support elements to support the wafer. The wafer support loaded with the wafer is inserted into the thermal treatment chamber so that the wafer and the wafer support are positioned between the top section and the bottom section. The wafer is individually processed in the thermal treatment chamber. After processing the wafer, the wafer support is removed from the thermal treatment chamber.

ABSTRACT

Method For Transferring Wafers And Ring

For wafer processing, wafers are transferred between a thermal treatment chamber and a thermal treatment installation. The treatment chamber has a top section and a bottom section between which the wafer is accommodated during treatment. The thermal treatment installation has a loading chamber having loading means and transport means. The wafer is place on a wafer support while in the loading chamber, wherein the wafer support is configured as a ring having support elements to support the wafer. The wafer support loaded with the wafer is inserted into the thermal treatment chamber so that the wafer and the wafer support are positioned between the top section and the bottom section. The wafer is individually processed in the thermal treatment chamber. After processing the wafer, the wafer support is removed from the thermal treatment chamber.

10/009851

Method for transferring wafers and ring.

The present invention relates to a method according to the preamble of Claim 1. US 5 162 047 discloses a thermal treatment installation which comprises a thermal treatment chamber, a "wafer boat"/rings assembly, a loading device and a transport device. With this arrangement the loading device serves to place wafers in and to remove wafers from the assembly and the transport device serves to place the assembly in and remove the assembly from the thermal treatment chamber.

The assembly consists of a frame to which a large number of rings are joined equally spaced, with their flat sides positioned above one another. The rings are each provided with a recess, which is not specified in more detail, in the inner edge, on which a wafer can be placed by the loading device.

After loading a large number of wafers, the assembly is moved by the transport device to the thermal treatment chamber to subject all wafers, located on the recesses, simultaneously to a treatment in which a heat treatment takes place.

In installations as disclosed in US 5 162 047 the wafers remain in contact with the rings during the entire heat treatment.

During heat treatment of a substrate, for example a silicon wafer, plastic deformation of the wafer can occur. In the case of silicon at temperatures higher than 900 - 1000 °C the mechanical strength of the wafer decreases substantially and plastic deformation can occur more easily than at room temperature. The deformation of silicon wafers occurs because crystal planes can shift over one another under the influence of stresses present or generated in the material. This is known by the term "slip". This slip can lead to warping of the wafer such that this is detectable with the naked eye.

Two sources of stress which give rise to slip will be present in the material. Firstly, the force of gravity, which in the case of horizontally positioned wafers is exerted uniformly over the entire surface thereof, in combination with the wafer support, which in general takes place at only a few points. This leads to local mechanical stresses, in particular on and close to the support points, which are also termed gravitational stresses.

Secondly, there is a temperature gradient over the wafer which leads to a non-uniform expansion of the wafer with corresponding mechanical stresses, also referred to as thermal stresses. This temperature gradient over the wafer occurs in particular on introducing it into a reactor and removing it therefrom. In general the temperature in the reactor will be

appreciable, for example 900 - 1000 °C, in order to achieve an adequate throughput time. If the ambient temperature is room temperature, on introduction of the wafer into or removal of the wafer from the reactor a substantial temperature gradient will be produced, with the resultant stresses. After all, the thermal capacity is relatively low because of the limited thickness and the large radiating surface of the wafer.

In installations as disclosed in US 5 162 047 the wafers are thus also subjected to a temperature difference during heating and cooling at those locations where there is contact with the ring, since the ring has a certain thermal capacity. So as not to allow temperature differences during loading into and unloading from the thermal treatment installation to become so large that mechanical stresses in the wafer lead to plastic deformation, transport of the combination into and out of the thermal treatment chamber must always take place at a suitable speed.

Moreover, the connection between the rings and the frame gives rise to an additional difference in thermal capacity in the rings which, as a result of the positioning of the connection, can lead to local deviation of the temperature in the ring and the wafer, as a result of which mechanical stresses can also be produced locally in the wafer during heating/cooling. Local adverse deformation of the wafer can occur as a result.

In some installations treatment is not carried out on a large number of wafers at the same time, as in US 5 162 047, but, for reasons specific to the treatment process, only one wafer is treated at a time. For such thermal treatment installations in which only a single wafer is treated per thermal treatment it is customary according to the prior art to place the wafer in, or remove the wafer from, the thermal treatment chamber individually, that is to say directly with the aid of a transport mechanism and without an auxiliary support such as, for example, a wafer ring.

The present invention relates in particular to contact-free treatment of a wafer. For this treatment the wafer in a reactor is supported uniformly over the entire surface by a gas stream, so that no gravitational stresses can arise during the treatment. The top section and bottom section of the reactor, between which the wafer is accommodated, can be heated very uniformly so that no temperature gradient of any significance is produced over the wafer during the treatment. However, it has been found that during loading or unloading of the wafer the abovementioned stresses can still occur, as a result of which slip takes place. After all, according to the prior art the wafer is picked up by a cold gripper for introduction and removal, high local temperature gradients are produced close to the support points and slip

occurs. Likewise, an appreciable temperature gradient is produced over the wafer as a whole. This gradient has two components: a linear and a radial component. The linear component arises because the wafer is withdrawn from between the two hot reactor bodies (top section and bottom section) in a linear movement. The radial component arises because the edge of the wafer is able to radiate its heat over a wider angle than the mid section of the wafer. The radial gradient in particular leads to harmful stresses.

The aim of the present invention is further to restrict or completely to preclude the slip in a wafer during transport into and out of the thermal treatment chamber and in particular during the contact-free treatment.

This aim is achieved with a method as described above having the characterising features of claim 1.

According to the invention, introduction of the wafer into and removal of the wafer from the thermal treatment installation takes place while a ring is arranged around said wafer. The ring also remains present during this treatment. If, according to a preferred embodiment of the invention, the wafer is treated contact-free, the wafer will be moved away from the ring and more particularly from the support points thereof during the treatment by means of suitable control of gas streams. This displacement can be very slight. The internal diameter of the ring according to the invention is only slightly larger than the external diameter of the wafer.

It is pointed out that arranging a ring around a wafer in order to restrict the temperature gradient over the wafer is known per se. The so-called "rapid thermal processing system" with which a wafer is heated very rapidly with the aid of lamps is described in US-A 4 468 259. With this system the wafer is mechanically supported and the radial temperature gradient in particular leads to slip because of heat loss at the edge of the wafer. This slip is appreciably reduced by arranging a ring which absorbs thermal radiation around the wafer holder with a diameter somewhat larger than the diameter of the wafer. However, this ring is not used for transport of the wafer into and out of the reactor, so that the abovementioned stresses still arise during loading/unloading. This also applies in the case of the ring arranged around a wafer as described in US Patent 5 334 257. Here again the thermal capacity of the edge region of the wafer is increased and the edge will heat up less rapidly and a less pronounced radial temperature gradient will thus be produced over the wafer.

In US 4 468 259 the ring is located in a fixed position in the thermal treatment chamber. In US 5 334 257 the rings are arranged in a wafer rack and the rings serve only as

transport means when transporting all wafers simultaneously.

The rings according to the invention can, of course, be handled by any robot known from the prior art.

The invention also relates to a thermal treatment installation/ring combination, wherein said thermal treatment installation comprises a treatment chamber delimited by two sections located opposite one another, wherein at least one of said sections is provided with a gas supply for floating positioning of a wafer between said sections, wherein said ring is designed to be placed between said sections, wherein in the operating position the distance between said two sections at the location of said ring essentially corresponds to the thickness of said ring and wherein at least three radial gas passages are arranged between said ring and the section concerned. Using such a combination of thermal treatment installation and ring it is possible accurately to determine the horizontal position of a wafer in a floating wafer reactor. In general, when positioning the wafer horizontally a gas stream will move towards the wafer both from the bottom and from the top of the reactor chamber in order to position said wafer accurately between the top section and bottom section of the reactor. For positioning in the horizontal plane a ring which is provided with outflow openings for said gas can be arranged around the wafer. It has been found that if the wafer moves towards a particular edge of the ring the outflow opening located in that position will be closed off to some extent, as a result of which a rise in the pressure of the gas occurs between the ring and the related edge, as a result of which the ring is pushed back towards the centre again. This is promoted in that the other openings allow more gas through, as a result of which a lowering in pressure occurs at these locations. In this way, particularly stable positioning is obtained and it is possible to work with a very small width of the gap between wafer and ring, for example approximately 0.2 mm. As a result of the use of such a ring the construction of the reactor walls, that is to say the top section and bottom section, can be appreciably simplified and can be made essentially flat. The passage through which the gas flows between the ring and the wall of the reactor can be made either in the wall of said reactor or in the top or bottom of the ring or in both. Lateral positioning of the wafer in the reactor is provided with the aid of the constructions according to the invention.

During introduction and removal of the wafer/ring combination the wafer can bear on support points on the ring. However, it is also possible to provide a separate auxiliary element equipped with support pins which extend through grooves or openings made in the reactor walls or in the top or bottom of the ring as described above, the ring and the wafer bearing on

said support pins during movement. In a preferred variant said auxiliary element is likewise annular.

In a further preferred embodiment of this variant the support pins are provided with internal channels which at one end open onto the contact surface with the wafer and at the other end are in communication with an internal channel in the auxiliary ring, which channel is connected to vacuum means in order to produce a vacuum in the channels. As a result of the vacuum the wafer is pressed against the contact surface of the support pins with a greater force than just by the force of gravity exerted on the wafer and the wafer will shift less rapidly in the horizontal plane during acceleration or retardation.

The invention also relates to a thermal wafer treatment installation/ring combination comprising a thermal wafer treatment installation having at least one receptacle for wafers, wherein said receptacle is constructed to receive a ring in such a way that the ring is removable and wherein each ring is designed to accommodate and support a wafer therein.

The invention will be explained in more detail below with reference to illustrative embodiments shown in the drawing. In the drawing:

Fig. 1 shows a perspective view of a first embodiment of the ring according to the invention with a wafer removed therefrom;

Fig. 2 shows, diagrammatically, in cross-section, the ring according to Fig. 1 with wafer during introduction into a reactor;

Fig. 3 shows, diagrammatically, the ring with wafer according to Fig. 2 during the treatment in the reactor;

Figs 4a-c show, in cross-section, various variants of the ring according to the invention;

Figs 5a,b show further variants provided with heating means;

Fig. 6 shows a plan view of a further embodiment of the ring according to the invention;

Fig. 7 shows a side view of the ring with wafer according to Fig. 6;

Fig. 8 shows a variant of Figs 6 and 7 with auxiliary ring,

Fig. 9 shows a side view of a construction according to Fig. 8 introduced into a reactor,

Fig. 10 shows a variant of Figs 6 and 7 with auxiliary ring and

Fig. 11 shows a side view of a construction according to Fig. 8 introduced into a reactor.

A first embodiment of the ring according to the invention is shown in perspective in Fig. 1 and is indicated in its entirety by 1. This ring consists of a somewhat thicker outer edge

2 and a thinner inner edge 3. Three support pins 4 are provided. The ring 2 is provided with a handling portion 5 for fixing to some sort of handling robot. A wafer is indicated by 6. The external diameter of the wafer 6 is somewhat smaller than the internal diameter of inner edge 3, such that the wafer 6 bears on the support points 4 during transport thereof. Ring 1 is intended for such transport, as can be seen from Fig. 2. This figure shows the introduction of the wafer 6 into a reactor 10 consisting of a top section 11 and a bottom section 12 which are heated in some manner known from the prior art. During introduction the wafer bears on the support pins 4.

After the wafer has been introduced into the reactor 10 and the reactor is closed in some way, gas streams 13 and 14 are activated, as a result of which the wafer comes away from the support pins 4 and starts to float and can be treated (Fig. 3). After treatment the gas streams 13 and 14 are switched off and the wafer returns to the support pins 4 and is removed from the reactor. During introduction and removal the high heat gradient which is produced over the wafer is essentially compensated for by the presence of the ring 1. After all, as a result of the relatively high thermal capacity of the ring, more rapid cooling at the edge of the wafer than in the centre thereof will be prevented. The cooling characteristics or heating characteristics of the wafer during transport can be controlled by the selection of the material and control of the wall thickness of the ring and the distance between the edge of the wafer and inner edge 3.

It must be understood that it is not necessary to allow the wafer to rest on the support points during transport. In principle it is also possible to provide an arrangement by means of which the wafer is in the floating state during transport. By this means it is guaranteed that there is no critical temperature transition at the support points.

As described above, the outer edge 2 of the ring 1 is made somewhat thicker. By this means mechanical strength is provided and the thermal capacity increases. The differences between inner edge 2 and outer edge 3 can comprise any construction conceivable in the state of the art. A few examples are given in Figs 4a - c.

Moreover, it is possible to supply heat from the ring during transport of the wafer. For this purpose heating elements 16 can be fitted, as is shown in Fig. 5. In the case of Fig. 5a the material of the ring will consist of a material that transmits radiation, such as quartz material. Consequently the distance from the heating element 16 to the inner ring 3 does not constitute a problem. In the embodiment according to Fig. 5b the characteristics of the ring in respect of the transmission of radiation are less important because the heating element is closer to the

wafer.

Fig. 6 shows a plan view of a further variant of the ring according to the invention. This ring is indicated in its entirety by 21. The support pins are indicated by 24. In contrast to the rings described above, radial gas passages are present, which are indicated by 22. In this case these passages are grooves. Fig. 7 shows the various features in cross-section during operation. It can be seen that gas stream 14 which holds the wafer in the middle between the top section 11 and the bottom section 12 is deflected and moves away in the radial direction over the wafer. However, the gases are only able to escape from the environment of the wafer through the grooves 22. As a result of using the ring the x-y position of the wafer is accurately determined. After all, if the wafer 6 moves towards one of the grooves 22 the somewhat obstructing effect of the wafer will mean that less gas can be discharged at that location. As a result the pressure rises at that location and the wafer will move back.

A variant is shown in Fig. 8, the ring 31 shown in this figure not being provided with support points. A further ring 41 is arranged around ring 31 and this ring is provided with support pins 34 which extend through the gas discharge grooves 32 which have been made in the bottom section 12 of the reactor. Fig. 9 shows a cross-section of this variant, introduced into a reactor.

A variant is shown in Fig. 10, the ring 31 in this figure not being provided with support points. A further ring 51 is arranged around ring 31 and this ring is provided with support pins 54 which extend through the gas discharge grooves 32 which have been made in the bottom section 12 of the reactor. The support pins 54 are provided with internal channels 56 which at one end open onto the contact surface 57 with the wafer and at the other end are in communication with an internal channel in the auxiliary ring 51, which is connected via communication passage 55 to vacuum means (not shown) in order to produce a vacuum in the channels. As a result of the vacuum the wafer is pressed against the contact surface of the support pins with a greater force than just by the force of gravity which is exerted on the wafer and the wafer will shift less rapidly in the horizontal plane on acceleration or retardation. Fig. 11 shows a cross-section of this variant, introduced into a reactor.

Using the construction described in Figs 6 - 9, the top and bottom section of the reactor, that is to say sections 11 and 12, can be produced in a particularly simple manner. In this embodiment radial positioning is achieved with the aid of the ring 21, 31. With this arrangement the boundary surface of the top section 11 and bottom section 12 with the reactor chamber can be essentially flat, a few grooves having been milled therein.

Those skilled in the art will understand from the large number of variants that have been described above that further developments are possible without going beyond the scope of the present invention as described in the appended claims.

Claims

1. Method for transferring a wafer (6) into and out of a thermal treatment chamber, for treating one wafer at a time, said treatment chamber being associated with a thermal treatment installation (10) which comprises a loading chamber, out of or into said loading chamber which has a temperature differing from that of said thermal treatment chamber, loading means and transport means being provided therefor in the loading chamber,
characterised in that in the loading chamber one of a set of wafers (6) and a ring (1) are combined to give, or separated from, a wafer/ring combination by the loading means and individual wafer/ring combinations are individually introduced into and removed from the thermal treatment chamber by the transport means.

2. Method according to Claim 1, characterised in that during movement of the wafer/ring combination the ring is handled mechanically and the wafer bears on support points on said ring.

3. Method according to Claim 1, characterised in that during movement the ring and the wafer are supported by an auxiliary element, which auxiliary element is handled mechanically.

4. Method according to Claim 3, wherein vacuum is used in the transport means on the contact surface between wafer (6) and auxiliary element in order to hold the wafer in place.

5. Method according to Claim 1, wherein in said thermal treatment installation the essentially horizontal wafer surrounded by the ring is brought a slight distance of less than 1 mm away from, or in contact with, a horizontal and essentially flat heated reactor section in said thermal treatment installation by vertical movement of the wafer with respect to the heated reactor section.

6. Method according to Claim 1, wherein the essentially horizontal wafer is moved a vertical distance away from the ring in said thermal treatment chamber.

7. Method according to Claim 6, wherein contact-free treatment of the wafer takes place in said thermal treatment chamber, the wafer being moved by a gas stream a vertical distance away from the ring (1).

8. Method according to Claim 1, characterised in that the thermal treatment installation (10) comprises a transport chamber which is connected to the loading chamber and to the thermal treatment chamber.

9. Method according to Claim 8, wherein the wafer (6) is surrounded, without contact, by the ring (1) in said transport means.

10. Method according to Claim 9, wherein the wafer (6) is a vertically spaced from the support points (4) of the ring (1) by a gas stream (13, 14).

11. Thermal treatment installation/ring combination comprising a loading chamber, loading means, transport means and a thermal treatment chamber for carrying out a thermal treatment on one wafer at a time, characterised in that the transport means are equipped to move individual wafer/ring combinations from the loading chamber into the thermal treatment chamber and vice versa and in that the treatment chamber is designed to accommodate said ring surrounding the wafer.

12. Thermal treatment installation/ring combination according to Claim 11, characterised in that the ring is designed to support said wafer at least during transferral.

13. Thermal treatment installation/ring combination according to Claim 12, characterised in that the ring is mechanically joined to the transport means.

14. Thermal treatment installation/ring combination according to Claim 11, characterised in that the treatment chamber is designed to accommodate an auxiliary element for supporting the ring and the wafer at least during transferral.

15. Thermal treatment installation/ring combination according to Claim 14, characterised in that said auxiliary element is mechanically joined to the transport means.

16. Thermal treatment installation/ring combination according to Claims 11 - 14, characterised in that said ring is provided with heating means.

17. Thermal treatment installation/ring combination, wherein the thermal treatment installation (10) comprises a treatment chamber delimited by two opposite sections (11, 12), at least one of said sections being provided with a gas supply for positioning a wafer (6) floating between said sections, said ring (21, 31) being embodied to be placed between said sections,

characterised in that

in the operating position the distance between said two sections (11, 12) at the location of said ring essentially corresponds to the thickness of said ring and in that at least three radial gas passages (22) are arranged between said ring (21, 31) and the relevant section (11, 12).

18. Thermal treatment installation/ring combination according to Claim 17, wherein said passages have been made in said sections (11, 12).

19. Ring combination comprising a ring (31) and a support ring (41), the internal

diameter of which is larger than the external diameter of the ring (31) and which is provided with support elements (34) which extend within the inner circumference of said ring (31).

20. Ring combination according to Claim 19, wherein said support elements comprise pins (34) which are accommodated in the grooves (32).

21. Ring combination according to Claim 20, wherein said support elements (34) are provided with internal channels which at one end open onto the contact surface with the wafer and at the other end are in communication with an internal channel in the auxiliary ring (41), which channel is connected to vacuum means in order to produce a vacuum in the channels.

Fig-1

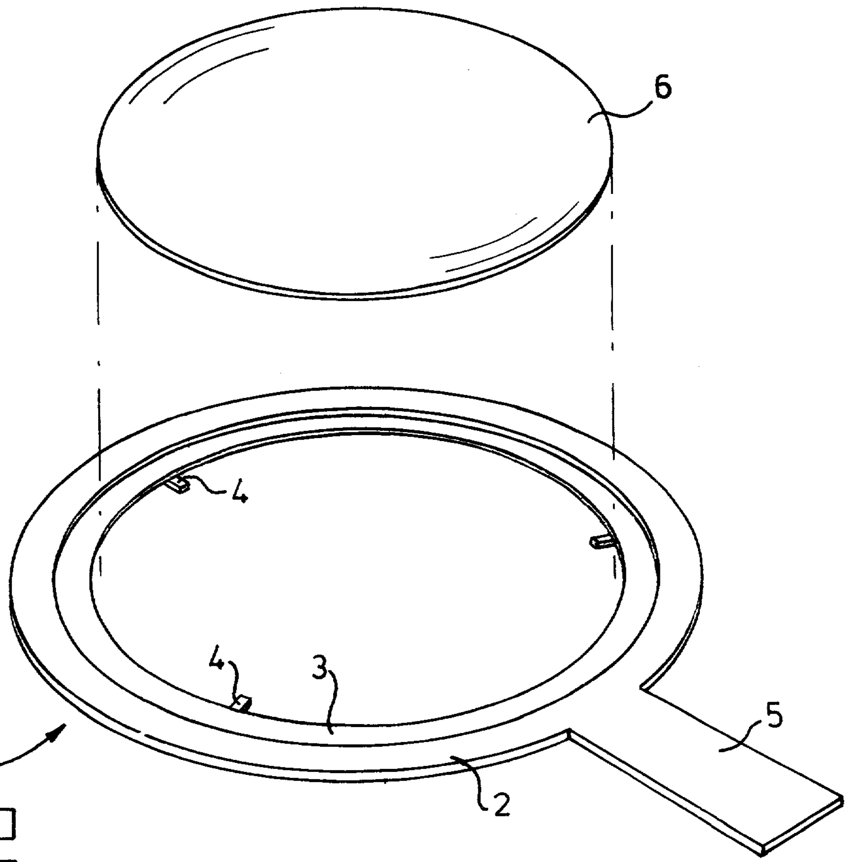


Fig-2

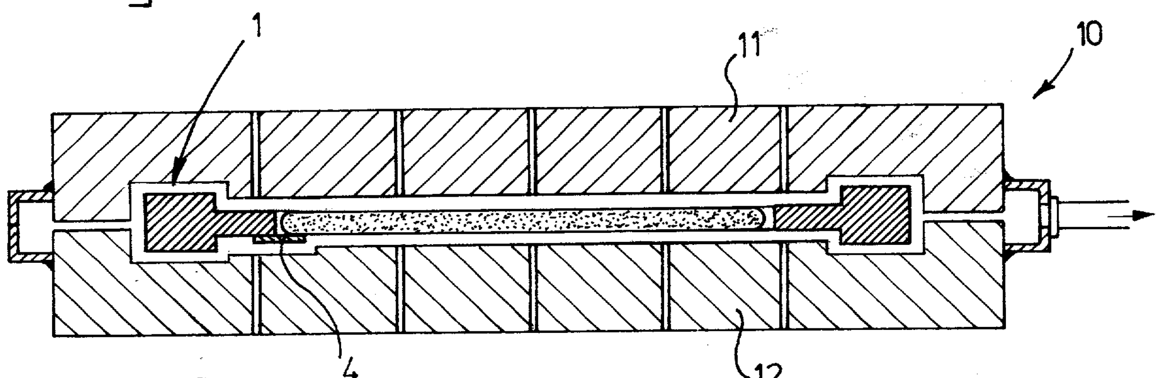


Fig-3

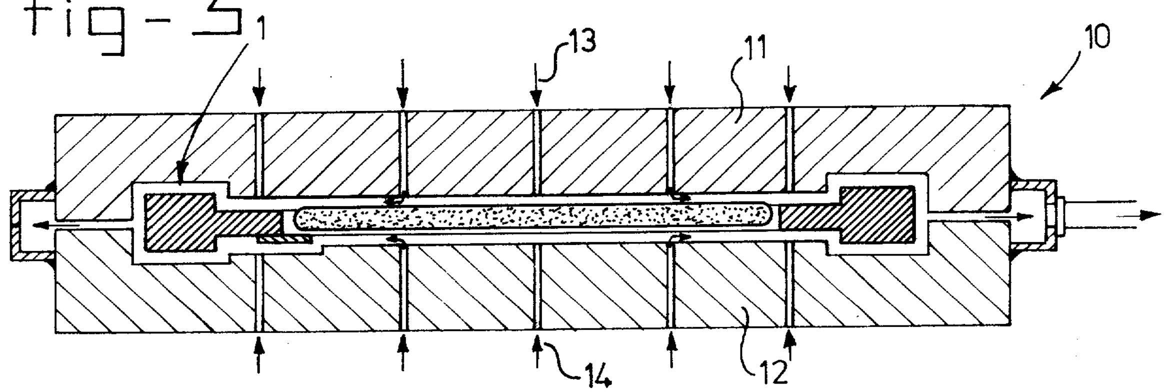


fig-4a

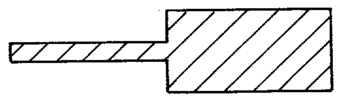
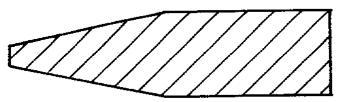


fig-4b



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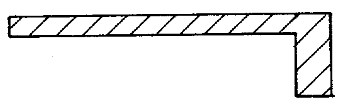


fig-5a

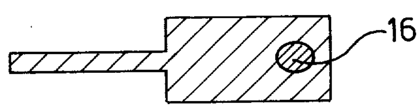


fig-5b

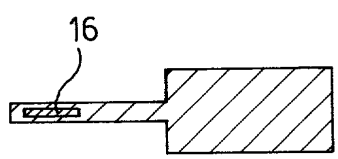
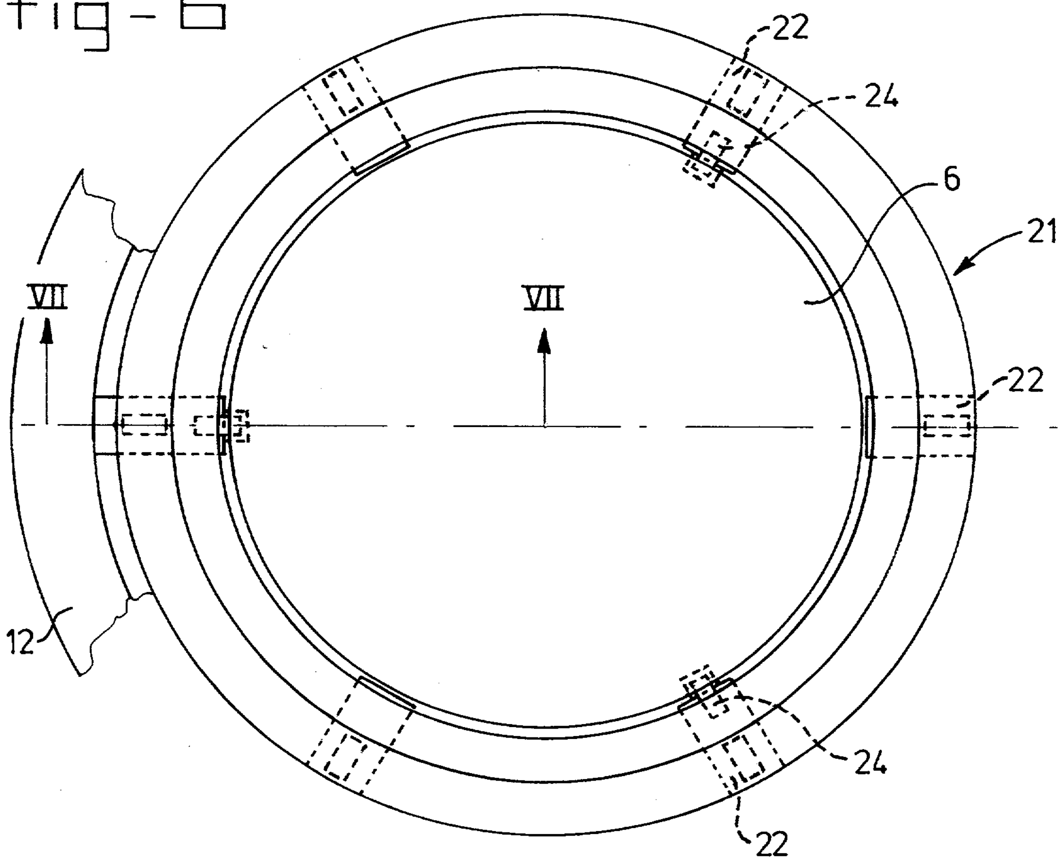


Fig-6



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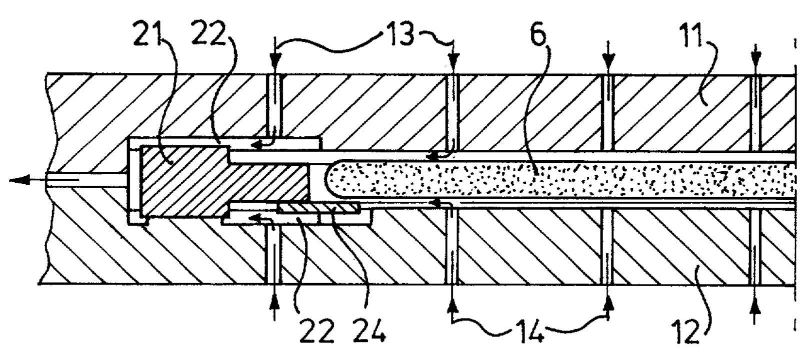


Fig - 8

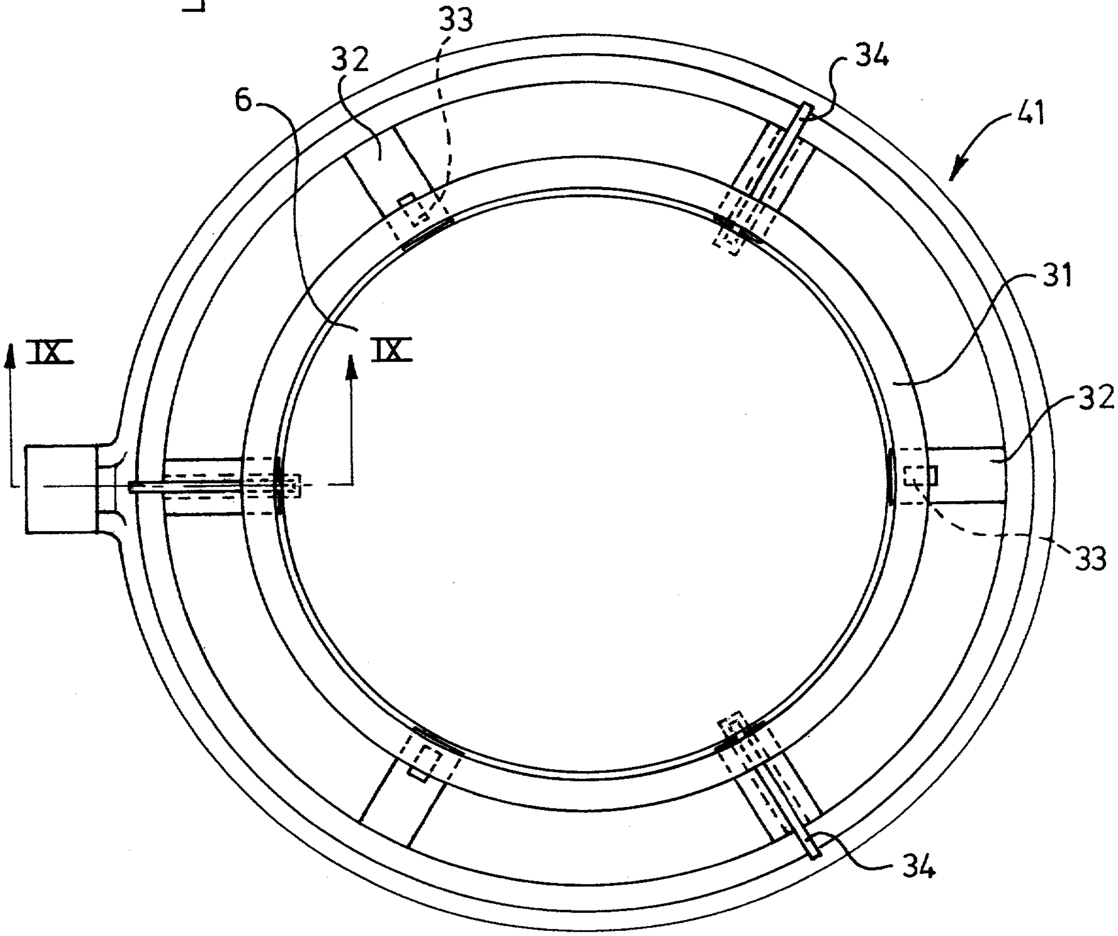


Fig - 9

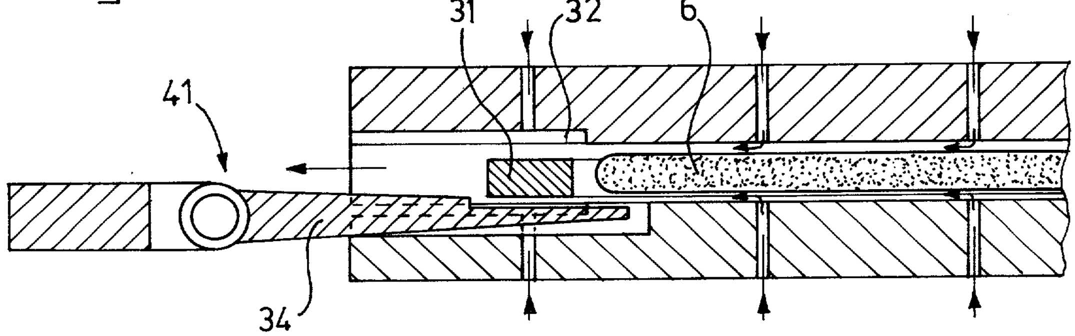


fig- 10

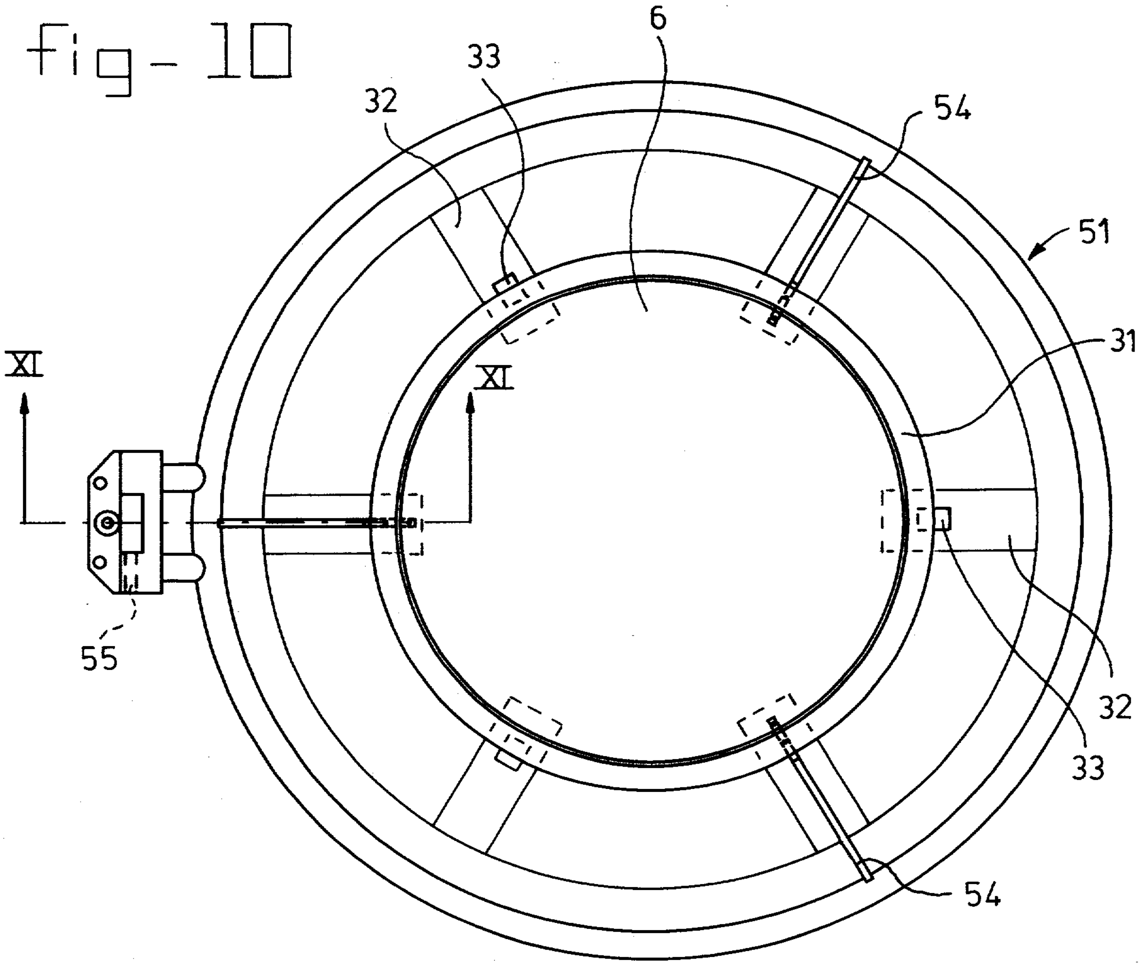
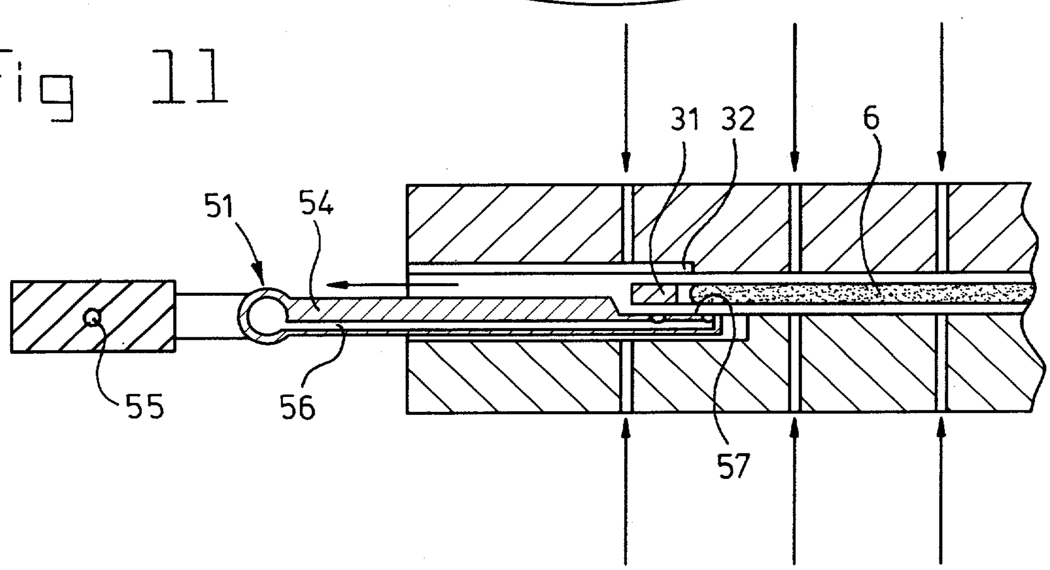


fig 11



COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL DESIGN, NATIONAL STAGE OF PCT OR CIP APPLICATION)

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Method for transferring wafers and ring

the specification of which: (complete (a), (b) or (c) for type of application)

REGULAR OR DESIGN APPLICATION

a. [ ] is attached hereto.
b. [ ] was filed on as Application
Serial No. and was amended on
(if applicable)

PCT FILED APPLICATION ENTERING NATIONAL STAGE

c. [X] was described and claimed in International application No. PCT/NL00/00297
filed on 8 May 2000
and as amended on (if any)

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, paragraph 1.56(a).

In compliance with this duty there is attached an information
disclosure statement 37 CFR 1.97

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35. United States Code paragraph 119 of any foreign application (s) for patent of inventor's certificate listed below and have also identified below any foreign application for patent of inventor's certificate having a filing date before that of the application on which priority is claimed.

(complete (d) or (e))

d. [ ] no such applications have been filed
e. [X] such applications have been filed as follows

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

Country	Application Number	Date of filing (day, month, year)	Date of Issue (day, month, year)	Priority claimed
The Netherlands	1012004	07.05.1999		Yes

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

____

____

CONTINUATION-IN-PART

(Complete this part only if this is a continuation-in-part application)

I hereby declare claim the benefit under Title 35, United States code, paragraph 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claim of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, paragraph 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, paragraph 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

____

(Application Serial No.) (Filing date) (Status) (patented, pending, abandoned)

____

(Application Serial No.) (Filing date) (Status) (patented, pending, abandoned)

POWER OF ATTORNEY

The undersigned hereby appoints the registrants of Knobbe, Martens, Olson & Bear, LLP, 620 Newport Center Drive, Sixteenth Floor, Newport Beach, California 92660, Telephone (949) 760-0404, CUTOMER No. 20,995, as its attorneys with full power of substitution to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected herewith. This appointment is to be to the exclusion of the inventor(s) and his attorney(s) in accordance with the provisions of 37 C.F.R. § 3.71.

Please use Customer No. 20,995 for all communications.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

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